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(54) **HEAT-GENERATING BODY, LAMINATED GLASS, AND DEFROSTER**

(57) Provided is a heating element capable of rapidly increasing the temperature even when the supply voltage is low. The heating element includes a resin film and heating wires provided on at least one surface of the

resin film and including a copper wire, wherein copper crystal grains forming the copper wire have a cross-sectional crystal size of 1.5 μm or more.

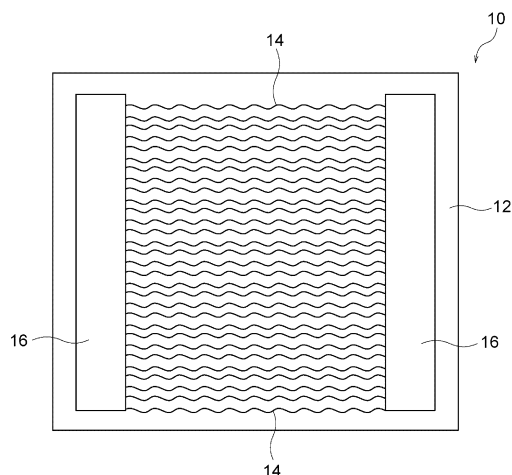


FIG. 1

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Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a heating element, a laminated glass, and a defroster.

BACKGROUND ART

10 **[0002]** Defrosters are widely used as an apparatus for preventing or removing frost, ice, fog, or the like on window glass of a vehicle such as an automobile. A defroster sends, for example, warm air free of water vapor intensively to a place to be dehumidified, thereby removing fog and ensuring visibility.

15 **[0003]** In recent years, a defroster using heating wires (electric heating wires) has been demanded for the purpose of improving heating efficiency, power saving in an electric vehicle, and the like. This type of defroster can remove fog by, for example, heating glass with heating wires sandwiched between glass sheets.

20 **[0004]** In such a defroster, it is known to use a resin film such as a polyvinyl acetal resin (for example, a polyvinyl butyral resin) having high light permeability as a glass intermediate film upon sandwiching the heating wires between the glass sheets. For example, Patent Literature 1 (JP2018-35036A) discloses a glass device for a vehicle, the device comprising a pair of glass substrates, a transparent resin intermediate film and a heating electrode sheet each sandwiched between the glass substrates, wherein a polyvinyl butyral resin is used as the transparent resin intermediate film.

25 **[0005]** A tungsten wire is generally used as a heating wire for a defroster. However, a diameter of a tungsten wire is as thick as about 30 μm , which makes fining difficult and therefore makes the visibility poor.

30 **[0006]** In order to address with such a problem, it has been proposed to use a copper pattern which enables fining as heating wires instead of tungsten wires. For example, Patent Literature 2 (JP2018-161889A) discloses a polyvinyl acetal resin film including a polyvinyl acetal resin layer, and an electrically conductive structure based on a metal foil, the electrically conductive structure disposed on the surface or inside of the polyvinyl acetal resin layer, wherein the electrically conductive structure is formed of copper or the like. In addition, Patent Literature 3 (JP2019-142763A) discloses subjecting a stacked body obtained by stacking a polyvinyl acetal resin film and a copper foil to thermocompression bonding to provide a polyvinyl acetal resin film including the copper foil bonded thereto, and then processing the copper foil bonded to the resin film to form an electrically conductive layer. Further, Patent Literature 4 (International Publication No. WO2017/090386) discloses a laminate including: a resin layer comprising a polyvinyl acetal resin; and a copper layer, wherein the copper layer is processed by a process such as a subtractive process, a semi-additive process, or a modified semi-additive process to form a wiring pattern.

CITATION LIST

PATENT LITERATURE

[0007]

40 Patent Literature 1: JP2018-35036A
 Patent Literature 2: JP2018-161889A
 Patent Literature 3: JP2019-142763A
 Patent Literature 4: WO2017/090386

SUMMARY OF INVENTION

45 **[0008]** Current general automobiles employ a low voltage such as, for example, 12 V as a voltage to be supplied to electrical parts such as a defroster. Therefore, a defroster to be used in a vehicle such as an automobile is required to increase the temperature rapidly even at a low voltage.

50 **[0009]** The present inventors have now found that in a heating element comprising a copper wire, controlling the cross-sectional crystal size of copper crystal grains forming the copper wire to 1.5 μm or more makes it possible to increase the temperature rapidly even when the supply voltage is low.

55 **[0010]** Therefore, it is an object of the present invention to provide a heating element capable of increasing the temperature rapidly even when the supply voltage is low.

[0011] The present invention provides the following aspects:

[Aspect 1]

[0012] A heating element comprising:

- 5 a resin film; and
heating wires provided on at least one surface of the resin film and comprising a copper wire,
wherein copper crystal grains forming the copper wire have a cross-sectional crystal size of 1.5 μm or more.

[Aspect 2]

- 10 **[0013]** The heating element according to aspect 1, wherein each of the heating wires has a thickness of 1 μm or more and 70 μm or less.

[Aspect 3]

- 15 **[0014]** The heating element according to aspect 1 or 2, wherein each of the heating wires has a line width of 1 μm or more and 30 μm or less.

[Aspect 4]

- 20 **[0015]** The heating element according to any one of aspects 1 to 3, wherein the heating wires are provided into at least one pattern selected from the group consisting of linear-shaped, wavy line-shaped, lattice-shaped, and net-shaped patterns.

[Aspect 5]

- 25 **[0016]** The heating element according to any one of aspects 1 to 4, wherein the resin film has a thickness of 1 μm or more and 1,000 μm or less.

[Aspect 6]

- 30 **[0017]** The heating element according to any one of aspects 1 to 5, wherein the resin film comprises a polyvinyl acetal resin.

[Aspect 7]

- 35 **[0018]** The heating element according to aspect 6, wherein the polyvinyl acetal resin is a polyvinyl butyral resin.

[Aspect 8]

- 40 **[0019]** The heating element according to any one of aspects 1 to 7, further comprising an additional resin film, wherein the heating wires are sandwiched between the additional resin film and the resin film.

[Aspect 9]

- 45 **[0020]** A laminated glass comprising:

- a pair of glass sheets; and
the heating element according to any one of aspects 1 to 8 sandwiched between the pair of glass sheets.

[Aspect 10]

[0021] A defroster comprising:

- 55 the laminated glass according to aspect 9; and
a voltage supply unit connected to the laminated glass and capable of applying voltage to the heating element.

[Aspect 11]

[0022] The defroster according to aspect 10, to be used for a vehicle in which a supply voltage to electrical parts is less than 24 V.

BRIEF DESCRIPTION OF DRAWINGS

[0023] Figure 1 is a schematic top view showing an example of a heating element of the present invention and is a diagram viewed from the surface of a resin film on the side where heating wires are provided.

DESCRIPTION OF EMBODIMENTS

Heating Element

[0024] Figure 1 shows an example of a heating element of the present invention. A heating element 10 shown in Figure 1 comprises a resin film 12 and heating wires 14. The heating wires 14 comprise a copper wire and are provided on at least one surface of the resin film 12. Copper crystal grains forming the copper wire has a cross-sectional crystal size of 1.5 μm or more. By controlling the cross-sectional crystal size of the copper crystal grains forming the copper wire to 1.5 μm or more in this way in the heating element 10 comprising the copper wire, the temperature can be increased rapidly even when the supply voltage is low.

[0025] The mechanism is not necessarily certain but is considered to be due to the fact that by increasing the cross-sectional crystal size of the copper crystal grains to 1.5 μm or more, the thermal diffusion at the grain boundaries is accelerated to shift the resistance. Specifically, calorific value W is proportional to the square of voltage V and inversely proportional to resistance R ($W = V^2/R$), and it is considered that by increasing the cross-sectional crystal size to 1.5 μm or more, the resistance can be controlled to be low and, as a result, calorific value W is increased. In other words, even if the cross-sectional area of each heating wire 14 is constant, calorific value W can be increased by controlling the cross-sectional crystal size of the copper crystal grains. As just described above, the heating element 10 of the present invention makes it possible to control calorific value W by making use of the characteristics of the copper wire included in the heating wires 14 and therefore also has an advantage that the degree of freedom in designing the heating wires 14 themselves can be ensured.

[0026] The copper crystal grains forming the copper wire has a cross-sectional crystal size of 1.5 μm or more, preferably 1.5 μm or more and 25 μm or less, more preferably 3.0 μm or more and 15 μm or less, and further preferably 3.0 μm or more and 6.0 μm or less. Thus, the temperature of the heating element 10 can be increased much more rapidly. The cross-sectional crystal size herein means the average crystal grain size in the cross-sectional direction of the copper wire. Specifically, the cross-sectional crystal size refers to a value obtained by analyzing a cross section of the copper wire in the thickness direction (height direction) by electron backscattering diffraction (EBSD). When the heating element 10 comprises another part (for example, a bus bar 16 in Figure 1) having the same crystal structure as the copper crystal grains forming the copper wire, the cross-sectional crystal size may be specified by subjecting a cross section of the above-described part instead of the copper wire to the EBSD analysis. The cross-sectional crystal size can be preferably calculated according to the procedure which will be described later in Evaluation (4a) in Examples.

[0027] The copper wire is formed of copper but may comprise: a different metal; an additive component and inevitable impurities derived from the raw materials; and the like. The content of copper in the copper wire is preferably 55% by mass or more and 100% by mass or less, and more preferably 90% by mass or more and 100% by mass or less. The content is defined as a semiquantitative value obtained through measurement with a scanning electron microscope with an energy dispersive X-ray spectrophotometer (SEM-EDS) after subjecting the heating wires 14 to cross-section processing. However, if vapor deposition is performed at the time of observation, platinum or gold is used, and the deposited element is excluded in calculating the semiquantitative value. The heating wires 14 may comprise a known additive or the like in addition to the copper wire and may be heating wires each obtained by subjecting a copper wire to, for example, coating in order to impart a desired function (for example, waterproofness and electrical insulation).

[0028] Each of the heating wires 14 preferably has a thickness (height) of 1 μm or more and 70 μm or less, more preferably 3 μm or more and 35 μm or less, further preferably 7 μm or more and 35 μm or less, and particularly preferably 9 μm or more and 18 μm or less. Thus, the temperature of the heating element 10 can be increased much more rapidly while the manufacturing is easy.

[0029] Each of the heating wires 14 preferably has a line width of 1 μm or more and 30 μm or less, more preferably 1 μm or more and 20 μm or less, further preferably 3 μm or more and 15 μm or less, and particularly preferably 3 μm or more and 10 μm or less. Thus, the temperature of the heating element 10 can be increased much more rapidly, and a good visibility can be ensured when the heating element 10 is used as a defroster, while the manufacturing is easy. The heating wires 14 may be provided into a pattern, such as a lattice shape, where the heating wires intersect with each other. In this case, the

parts where the heating wires 14 intersect with each other are excluded from the calculation of the line width.

[0030] The heating wires 14 preferably include at least one pattern selected from the group consisting of linear-shaped, wavy line-shaped, lattice-shaped, and net-shaped patterns, and more preferably includes a wavy line-shaped pattern. The length of each heating wire 14 may be determined appropriately according to the pattern shape of the heating wires 14, the size of the object (such as window glass of a vehicle) where the heating element 10 is used, and the like, and is not limited.

[0031] When the heating element 10 is used for a laminated glass or a defroster, the resin film 12 functions as a glass intermediate film. From this viewpoint, the resin film 12 is preferably formed of a resin having light permeability, and examples of such a resin include polyvinyl acetal resins, polyurethane resins, and ethylene-vinyl acetate copolymers. The resin film 12 more preferably comprises a polyvinyl acetal resin. Preferred examples of the polyvinyl acetal resin contained in the resin film 12 include polyvinyl butyral resins in view of penetration and impact resistance, transparency, and the like as a glass intermediate film. The resin film 12 may comprise a known additive, and examples of the additive that can be contained in the resin film 12 include a plasticizer, an antioxidant, an ultraviolet absorber, and an adhesion control agent. In any case, as the resin film 12, a commercially available resin film (for example, a polyvinyl acetal resin film) may be used as it is, or the resin film 12 may be produced by employing an already known method for manufacturing a resin film (see, for example, Patent Literatures 2 and 3) without a modification or appropriately modifying the method.

[0032] The resin film 12 preferably has a thickness of 1 μm or more and 1,000 μm or less, more preferably 10 μm or more and 900 μm or less, and further preferably 80 μm or more and 900 μm or less, although not limited thereto. When the thickness of the resin film is within the ranges, good light permeability and feedability (that is, supportability to the heating wires 14) can be achieved.

[0033] In the heating element 10, the proportion of the regions where the resin film 12 and the heating wires 14 are not in contact in the surface of the resin film 12 on the heating wire 14 side (that is, aperture ratio) is preferably 70% or more and 98% or less. Thus, a much better visibility can be ensured.

[0034] The heating element 10 may further comprise an additional resin film (not shown) in addition to the resin film 12. In this case, the heating wires 14 are preferably sandwiched between the additional resin film and the resin film 12. Thus, the penetration and impact resistance of the heating element 10 can be improved much more.

[0035] As shown in Figure 1, the heating element 10 may further comprise bus bars 16, wherein the heating wires 14 are connected to each bus bar 16. Each of the bus bars 16 may be produced using the same raw material (such as a copper foil) as that for the heating wire 14 through the same processes as those for the heating wire 14, and therefore may have the same crystal structure as that of the copper crystal grains forming the copper wire included in the heating wire 14.

Method for Manufacturing Heating Element

[0036] The method for manufacturing the heating element 10 is not limited, and the heating element 10 can be manufactured by appropriately changing the conditions in already known methods for manufacturing a heating element and a defroster. For example, the heating element 10 can be preferably manufactured by (1) providing a copper foil having a predetermined cross-sectional crystal size, (2) bonding or forming a resin film onto the copper foil, and (3) processing the copper foil to form heating wires in a predetermined pattern. Hereinafter, each of the steps (1) to (3) will be described.

(1) Providing Copper Foil

[0037] A copper foil in which copper crystal grains have a cross-sectional crystal size of 1.5 μm or more is provided. The copper foil may be any of an electrodeposited copper foil and a rolled copper foil but is preferably an electrodeposited copper foil. When an electrodeposited copper foil is manufactured, the cross-sectional crystal size can be controlled by changing the additive concentration, the current density, and the like in forming the copper foil by electrodeposition. Alternatively, a commercially available copper foil satisfying the above-described range of the cross-sectional crystal size may be selected.

[0038] The copper foil may be a copper foil as formed by electrodeposition or rolling foil production (that is, a raw foil) or may take a form of a surface-treated copper foil obtained by subjecting at least one of the surfaces of a copper foil to surface treatment. The surface treatment can be any of various types of surface treatment which are performed in order to improve or impart a certain characteristic (for example, rust proofing performance, humidity resistance, chemical resistance, acid resistance, heat resistance, and adhesion to a resin film) in a surface of the copper foil. At least one surface of the copper foil may be subjected to the surface treatment or both surfaces of the copper foil may be subjected to the surface treatment. Examples of the surface treatment to which the copper foil is subjected include rust proofing treatment, silane treatment, roughening treatment, and barrier-forming treatment. Further, the copper foil may take a form of a carrier-attached copper foil comprising a carrier and a release layer in order to improving handleability.

[0039] An electrodeposited copper foil has a characteristic that as electrodeposited copper is deposited in the thickness direction during the copper foil production, the size of copper crystal grains becomes larger. In other words, the size of the copper crystal grains at one surface and its vicinity of the electrodeposited copper foil and the size of the copper crystal

grains at the other surface and its vicinity of the electrodeposited copper foil are generally different. Therefore, by performing etching from one surface of the electrodeposited copper foil, copper crystal grains having a smaller crystal size (or a larger crystal size) can be removed selectively. A copper foil in which copper crystal grains have a predetermined cross-sectional crystal size may be provided in this way. The copper foil may be etched after the resin film 12 is, as will be described later, bonded or formed onto the copper foil, and in such a case, the cross-sectional crystal size of the copper crystal grains forming the copper foil after the etching may be within the predetermined range.

(2) Bonding or Forming Resin Film onto Copper Foil

[0040] The resin film 12 is bonded or formed onto the copper foil provided in (1) to form a laminate. The resin film 12 is preferably bonded to the copper foil by thermocompression bonding or adhesion of the preliminarily provided resin film 12 to the copper foil. The temperature and pressure during the thermocompression bonding is not limited and may be determined appropriately according to the type of resin for forming the resin film 12.

[0041] On the other hand, the resin film 12 is preferably formed on the copper foil by coating the copper foil with a resin composition for forming the resin film 12 or applying a resin composition for forming the resin film 12 on the copper foil using a known method, such as a melt extrusion method, a casting method, and a coating method. Thus, the resin film 12 can be formed directly (formed in-situ) on the copper foil.

[0042] When an electrodeposited copper foil is used, the resin film 12 is preferably bonded or formed onto the copper foil so as to make the copper crystal grain size at the surface of the electrodeposited copper foil where the resin film 12 is adhered and its vicinity larger than the copper crystal grain size at the opposite side of the surface and its vicinity. Thus, the copper crystal grains having larger cross-sectional crystal sizes are left when the copper foil is etched from the opposite side of the surface where the resin film 12 is adhered. However, this does not apply to the case when the copper foil is not etched, the resin film 12 may be bonded or formed onto any of the surfaces of the electrodeposited copper foil.

(3) Processing Copper Foil

[0043] The copper foil is processed to provide the heating element 10 wherein the heating wires 14 and, optionally, bus bars 16 are formed on the surface of the resin film 12. The copper foil may be processed according to any of the known processes, and the process is not limited. For example, the heating wires 14 whose shape is a predetermined pattern and, optionally, the bus bars 16 can be formed by a process such as a subtractive process, a semi-additive process, or a modified semi-additive process, as disclosed in Patent Literature 4.

[0044] An additional resin film is optionally bonded or formed onto the heating element 10 so as to sandwich the formed heating wires 14. Bonding or formation of the additional resin film is not limited and may be performed in accordance with, for example, the above-described bonding or formation of the resin film 12 onto the copper foil.

Laminated Glass

[0045] The heating element 10 is preferably used for a laminated glass. Specifically, according to a preferred aspect of the present invention, there is provided a laminated glass comprising a pair of glass sheets and the heating element 10 sandwiched between the glass sheets.

[0046] The configuration of the laminated glass is not limited, and known configurations can be employed except that the laminated glass comprises the above-described heating element 10. The heating element 10 may be one such that the heating wires 14 are disposed so as to run over the whole surfaces of the glass sheets, or may be one such that the heating wires 14 are disposed so as to be provided in only a particular region of the glass sheets. The glass sheet is not limited, and, for example, commercially available glass for a vehicle can be employed as the glass sheet.

Defroster

[0047] The heating element 10 and the laminated glass comprising the heating element 10 are preferably used for a defroster. Specifically, according to a preferred aspect of the present invention, there is provided a defroster comprising the above-described laminated glass and a voltage supply unit connected to the laminated glass and capable of applying a voltage to the heating element 10.

[0048] The configuration of the defroster is not limited, and known configurations can be employed except that the defroster comprises the above-described heating element 10. When the heating element 10 comprises the above-described bus bar 16, the bus bar 16 and the voltage supply unit (such as an external power supply) are preferably connected electrically.

[0049] The defroster is preferably used for a vehicle in which the supply voltage to electrical parts is less than 24 V (for example, about 12 V). According to the defroster of the present invention, the temperature can be increased rapidly even at

such a low voltage, and therefore the window glass and the like in a vehicle can be warmed efficiently, so that frost, ice, fog, or the like can be prevented or removed.

EXAMPLES

[0050] The present invention will be more specifically described by the following examples.

Examples 1 to 3

[0051] Three types of copper foils were provided, and a resin film was bonded to these copper foils to provide laminates. Heating elements were produced by processing the obtained laminates and evaluations were conducted. Specifically, the procedures were as follows.

(1) Providing Copper Foils

[0052] Three types of commercially available copper foils (electrodeposited copper foils, thickness 12 μm) each having a different cross-sectional crystal size were provided.

(2) Bonding Resin Film to Copper Foil

[0053] A commercially available polyvinyl butyral resin film (thickness: 760 μm) in which adipic acid dihexyl ester is blended as a plasticizer was provided. The polyvinyl butyral resin film and the copper foils provided in (1) were laminated. At this time, the copper foil and the resin film were subjected to thermocompression bonding under the conditions of a temperature of 110°C, a pressure of 0.4 MPa, and a time of 20 seconds or shorter to provide a laminate in which the copper foil and the resin film were bonded.

(3) Producing Heating Element

[0054] A circuit was formed by a subtractive process on the obtained laminate to produce a heating element 10 in which heating wires 14 and bus bars 16 were provided on one surface of the resin film 12 as shown in Figure 1. Specifically, a dry film was bonded to the surface of the laminate on the copper foil side to form an etching resist layer. Then, this etching resist layer was exposed and developed to form a predetermined etching pattern. Thereafter, etching was performed with a copper etchant to strip the etching resist. Thus, 67 wavy line-shaped heating wires 14 each connected to the bus bars 16 and having a height of 12 μm , a line width of 30 μm , and a length of 8 cm were formed to provide the heating element 10.

(4) Evaluation

[0055] The characteristics of the heating element thus obtained were evaluated as follows.

(4a) Measurement of Cross-Sectional Crystal Size

[0056] The cross-sectional crystal size of copper crystal grains forming the copper wires was measured as follows using the obtained heating element 10. Firstly, cross section processing with a cross section polisher (CP) was performed from the surface of the heating element 10 on the heating wire 14 and bus bar 16 side along the thickness direction under a condition of an acceleration voltage of 5 kV. Thereafter, the cross section of the heating wires 14 was observed with an FE gun scanning electron microscope (manufactured by Carl Zeiss AG, Crossbeam 540) equipped with an EBSD detector (manufactured by Oxford Instruments, Symmetry). EBSD data were acquired using EBSD measurement software (manufactured by Oxford Instruments, Aztec 5.0 HF1), and the acquired EBSD data were converted into the OIM format. Measurement conditions for the scanning electron microscope during the observation were set as follows. However, with regard to the observation conditions such as the region width and the region height of the following conditions, appropriate values can be selected according to the size of the heating element 10 and/or the heating wires 14.

<Measurement Conditions for Scanning Electron Microscope>

[0057]

- Acceleration Voltage: 10.00 kV
- Step Size: 10 nm

- Region Width: 30 μm
- Region Height: 15 μm
- Scan Phase: Cu
- Sample Angle: 70°

[0058] The crystal distribution was measured using crystal size calculation software (manufactured by AMTEK, Inc., OIM Analysis v7.3.1 x64) based on the data converted into the OIM format to calculate the cross-sectional crystal size (average crystal size, "Grain Size-Average Area" on the software) of the copper crystal grains forming the copper wires and the bus bars 16. The results were as shown in Table 1. In the measurement of the crystal distribution, an orientation difference of 5° or more was regarded as a crystal grain boundary. However, the crystal structure of copper is a cubic crystal structure, and therefore the following (i) or (ii) was not regarded as a crystal grain boundary considering twin boundaries.

- (i) A twin boundary where the orientational relationship is 60° rotation around the <111> axis
- (ii) A twin boundary where the orientational relationship is 38.9° rotation around the <110> axis

(4b) Measurement of Temperature Increasing Rate

[0059] The temperature increasing rate was measured as follows using the obtained heating element 10. Firstly, the heating element 10 was placed on a workbench under a room temperature environment (about 25°C) in such a manner that the heating wires 14 faced toward the outside, and a power source (the voltage supply unit) was connected to the bus bars 16. An infrared thermography camera (manufactured by FLIR Systems Inc., FLIR C3) was adjusted in such a manner that the whole heating element 10 fell within the visual field for measurement, and then box measurement to show the minimum temperature and the maximum temperature in the visual field for measurement was performed to read the maximum temperature of the heating element 10. Thereafter, a voltage of 1.0 V was applied to the heating element 10 from the power source for 1 minute to increase the temperature of the heating element 10. The maximum temperature of the heating element 10 one minute after the application of the voltage was read with the infrared thermography camera in the same manner as before the application of the voltage. The difference in the maximum temperature of the heating element 10 before and after the application of the voltage was defined as increased temperature. The above operation was performed twice for each example to calculate the average value of the increased temperature. The results were as shown in Table 1.

[Table 1]

[0060]

Table 1

	Evaluations	
	Cross-sectional crystal size (μm)	Increased temperature (°C) after a voltage of 1.0 V is applied for 1 minute
Example 1	3.36	19.7
Example 2	1.67	16.0
Example 3*	1.35	15.1
* indicates a comparative example.		

Claims

1. A heating element comprising:

a resin film; and
 heating wires provided on at least one surface of the resin film and comprising a copper wire,
 wherein copper crystal grains forming the copper wire have a cross-sectional crystal size of 1.5 μm or more.

2. The heating element according to claim 1, wherein each of the heating wires has a thickness of 1 μm or more and 70 μm or less.

3. The heating element according to claim 1 or 2, wherein each of the heating wires has a line width of 1 μm or more and 30 μm or less.

4. The heating element according to claim 1 or 2, wherein the heating wires are provided into at least one pattern selected from the group consisting of linear-shaped, wavy line-shaped, lattice-shaped, and net-shaped patterns.

5. The heating element according to claim 1 or 2, wherein the resin film has a thickness of 1 μm or more and 1,000 μm or less.

6. The heating element according to claim 1 or 2, wherein the resin film comprises a polyvinyl acetal resin.

7. The heating element according to claim 6, wherein the polyvinyl acetal resin is a polyvinyl butyral resin.

8. The heating element according to claim 1 or 2, further comprising an additional resin film, wherein the heating wires are sandwiched between the additional resin film and the resin film.

9. A laminated glass comprising:

a pair of glass sheets; and

the heating element according to claim 1 or 2 sandwiched between the pair of glass sheets.

10. A defroster comprising:

the laminated glass according to claim 9; and

a voltage supply unit connected to the laminated glass and capable of applying voltage to the heating element.

11. The defroster according to claim 10, to be used for a vehicle in which a supply voltage to electrical parts is less than 24 V.

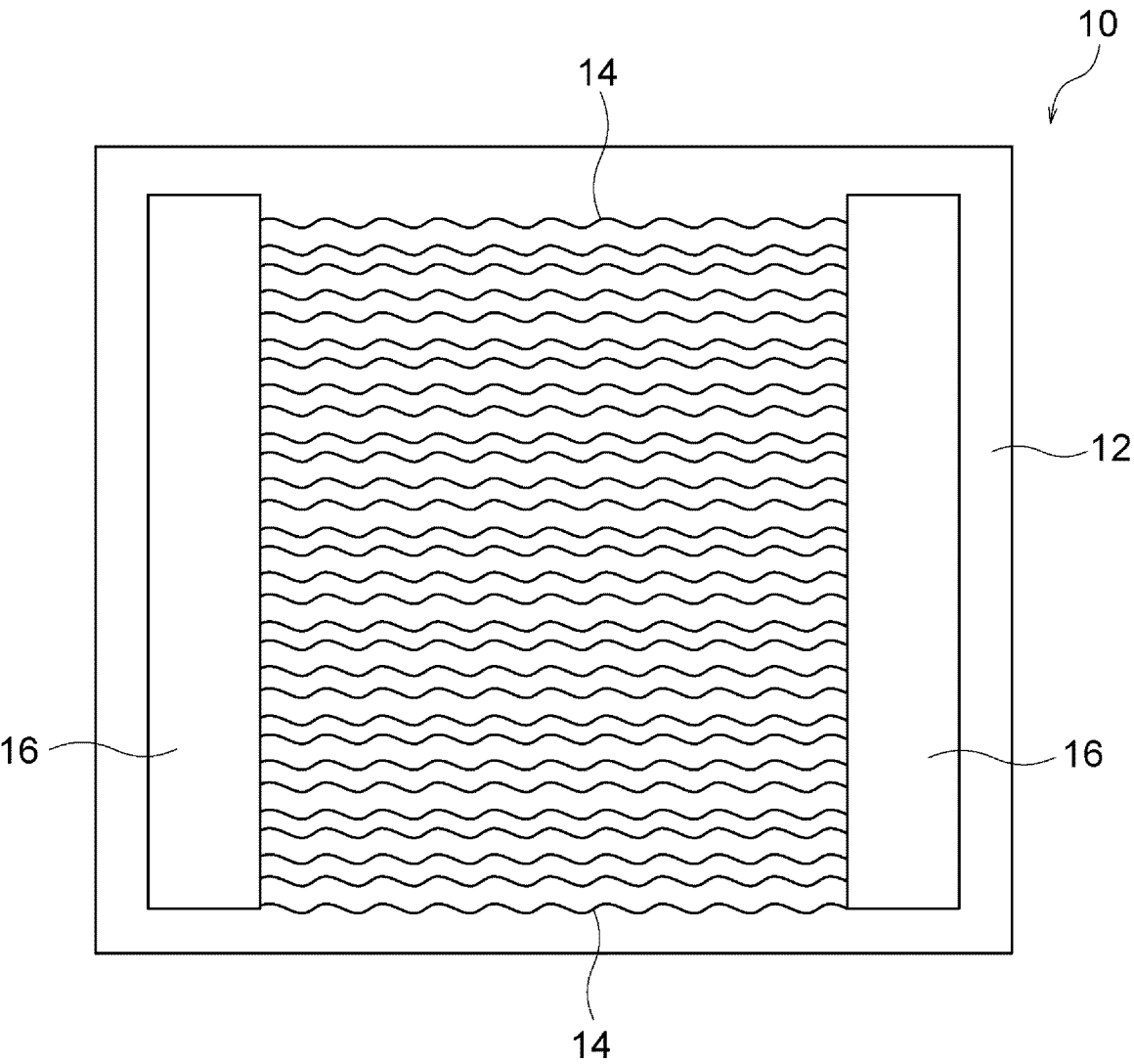


FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/001796

A. CLASSIFICATION OF SUBJECT MATTER

H05B 3/20(2006.01)i; **B60J 1/20**(2006.01)i; **C03C 27/12**(2006.01)i; **H05B 3/12**(2006.01)i; **H05B 3/84**(2006.01)i
 FI: H05B3/20 347; B60J1/20 C; C03C27/12 M; H05B3/12 A; H05B3/84

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H05B3/20; B60J1/20; C03C27/12; H05B3/12; H05B3/84

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2019/131963 A1 (KURARAY CO., LTD.) 04 July 2019 (2019-07-04) paragraphs [0002]-[0005], [0048], [0110]-[0125], fig. 5A-5C	1-11
Y	JP 2009-301796 A (SHIN-ETSU CHEMICAL CO LTD) 24 December 2009 (2009-12-24) paragraph [0013]	1-11
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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